

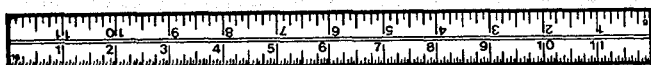
Chapter 3 READING MEASURING SCALES

The following chapter is designed to provide a basic understanding of how to read scales, dials, and gages. It will not provide any information on the actual use of the tools. Reference to this chapter will be made throughout the remainder of the manual.

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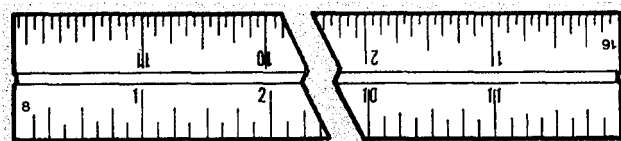
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READING THE SCALE OF A RULE OR TAPE



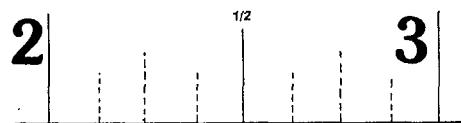
The more common type rules and tapes are divided into fractions, inches, and feet. Explained here are the scales on a 12-inch steel machinist's rule.

The rule is divided into twelve inches. The inches are further divided into eighths, sixteenths, thirty-seconds, and sixty-fourths.



Look at the rule. There is a small numeral marked on the end of the rule nearest the 1-inch mark. This numeral indicates the number of divisions per inch.

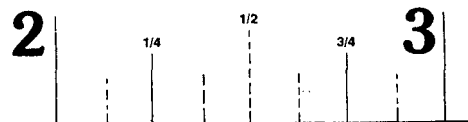
When referring to fractions, always use the reduced name. This is the smallest numerator (top number) and denominator (bottom number). For example, $\frac{3}{6}$ can be reduced to $\frac{1}{2}$ by dividing both the top and bottom by 3. Generally, fractions may be reduced to their lowest forms by repeated division by 2 or 3.



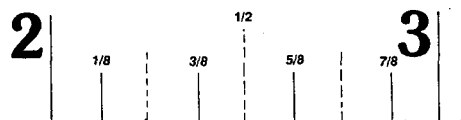
Look at the section between the "2" and the "3" on the edge marked with an "8" for eighths.

There are eight equally spaced lines. The lengths of these lines differ and indicate different fractions or parts of an inch.

The longest line is in the center and is equal to $\frac{4}{8}$ or $\frac{1}{2}$ inch.



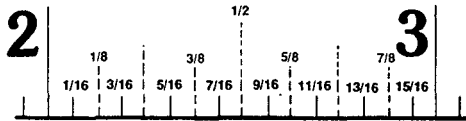
Each half-inch is divided in half by a slightly shorter line indicating $\frac{2}{8}$ or $\frac{1}{4}$ on the left and $\frac{6}{8}$ or $\frac{3}{4}$ on the right.



Each $\frac{1}{4}$ inch is divided in half by the shortest line which indicates $\frac{1}{8}$ inch, and will indicate $\frac{1}{8}$, $\frac{3}{8}$, $\frac{5}{8}$ and $\frac{7}{8}$.

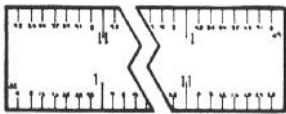
READING THE SCALE OF A RULE OR TAPE - Continued

Now turn the rule and look at the edge with a 16 marked on it.

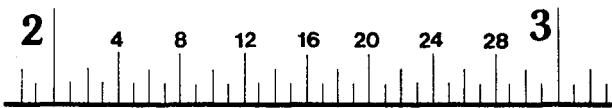


There are now 16 equal divisions between each inch. Since $2/16$ reduces to $1/8$, divide each $1/8$ into two equal parts producing $1/16$, $3/16$, $5/16$, $7/16$, $9/16$, $11/16$, $13/16$, and $15/16$.

Common tapes and rules usually are not graduated smaller than sixteenths. However, precision measurements require smaller graduations.



Look at the back of the machinist's rule. Find the edge marked 32 and once again look between the numbers "2" and "3."



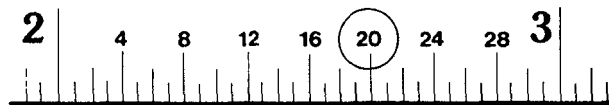
To read this rule, remember:

1. Sixteen divisions ($16/32$) are equal to $1/2$ inch.
2. Eight divisions ($8/32$) are equal to $1/4$ inch.
3. Four divisions ($4/32$) are equal to $1/8$ inch.
4. Two divisions ($2/32$) are equal to $1/16$ inch.

To read $2\text{--}5/8$ inches on the scale, first find the two inch mark, then determine the number of 32nds in $5/8$.

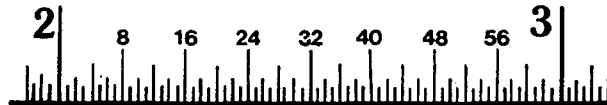
To determine the number of 32nds in $5/8$, remember four divisions or $4/32$ are equal to $1/8$ inch. If $1/8$ is equal to $4/32$, then $5/8$ is equal to $20/32$ as shown:

$$\begin{aligned} \text{If } 1/8 &= 4/32, \text{ then } 5/8 = 20/32 \\ (4 \times 5 &= 20) \end{aligned}$$



1. Find the $20/32$ reading on the scale as shown above.
2. Write the new fraction $2\text{--}20/32$ inches.

Finally, look at the edge marked 64. Each inch is now divided into 64 equal parts.



To read this rule, remember:

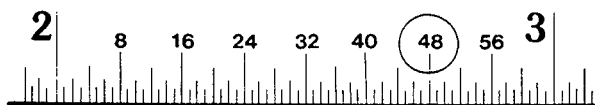
1. Thirty-two divisions ($32/64$) are equal to $1/2$ inch.
2. Sixteen divisions ($16/64$) are equal to $1/4$ inch.
3. Eight divisions ($8/64$) are equal to $1/8$ inch.
4. Four divisions ($4/64$) are equal to $1/16$ inch.
5. Two divisions ($2/64$) are equal to $1/32$ inch.

To read $2\text{--}3/4$ inches on this scale, first find the two inch mark. Next, determine the number of 64ths in $3/4$.

READING THE SCALE OF A RULE OR TAPE - Continued

To determine the number of 64ths in $\frac{3}{4}$, remember every sixteen divisions or $\frac{16}{64}$ are equal to $\frac{1}{4}$ inch. If $\frac{1}{4}$ is equal to $\frac{16}{64}$, then $\frac{3}{4}$ is equal to $\frac{48}{64}$ as shown:

$$\begin{aligned} \text{If } \frac{1}{4} &= \frac{16}{64}, \text{ then } \frac{3}{4} = \frac{48}{64} \\ & (16 \times 3 = 48) \end{aligned}$$

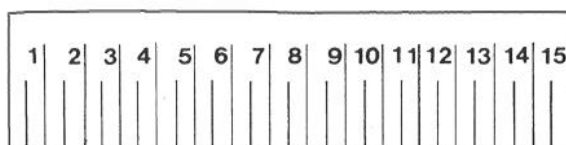
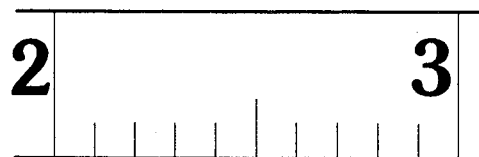


1. Locate the number 48 between the 2 and 3 inch marks on the scale.
2. Write the new fraction $\frac{2-48}{64}$.

READING A METRIC RULE

The metric system is based upon multiples of ten. For example, there are 10 millimeters in a centimeter and 100 centimeters in a meter.

The example provided will deal only with millimeters (mm).



The meter will become the starting point and from this, two additional scales can be developed for measuring. A meter divided by 100 equals a centimeter (cm), $\frac{1}{100}$ or 0.01 meter.

Next divide a centimeter (cm) by 10. This will equal a millimeter (mm), $\frac{1}{1000}$ or 0.001 meter.

Now let's look at a section of the rule between 2 cm and 3 cm.

There are 10 equal divisions which are equal to $\frac{1}{10}$ cm or 1 mm.

To measure 26 mm, first locate the longest line designated 2 cm or 20 mm.

Next count 6 additional lines to find 26 mm.

A table for converting from US Common to metric or from metric to US Common may be found inside the back cover of this manual.

